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## Test 789: Minneapolis-Moline 4 Star (Gasoline)

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# NEBRASKA TRACTOR TEST 789 - MINNEAPOLIS - MOLINE 4 STAR GAS

The University of Nebraska Agricultural Experiment Station

E. F. Frolik, Dean; A.W. Epp, Acting Director, Lincoln, Nebraska

## POWER TAKE-OFF PERFORMANCE

Hp	Crank shaft speed rpm	Fuel Consumption		Hp-hr per gal	Temp. Degrees F			Barometer inches of mercury
		Gal per hr	Lb per hp-hr		Cool- ing med	Air wet bulb	Air dry bulb	
MAXIMUM POWER AND FUEL CONSUMPTION								
Rated Engine Speed—Two Hours								
44.57	1750	4.146	0.567	10.75	177	58	75	28.960
Standard Power Take-off Speed (540 rpm)—One Hour								
41.25	1524	3.882	0.574	10.63	178	59	75	28.913
VARYING POWER AND FUEL CONSUMPTION—TWO HOURS								
41.21	1904	4.052	0.600	10.17	176	60	78	.....
0.00	1988	1.638	.....	.....	165	58	76	.....
20.84	1926	2.779	0.813	7.50	172	59	77	.....
44.67	1750	4.166	0.569	10.72	178	59	76	.....
10.60	1957	2.184	1.257	4.85	171	59	76	.....
30.94	1904	3.359	0.662	9.21	176	59	76	.....
AV 24.71	1905	3.030	0.748	8.16	173	59	76	28.868

## DRAWBAR PERFORMANCE

Hp	Draw-bar pull lbs	Speed miles per hr	Crank shaft speed rpm	Slip of drivers %	Fuel Consumption		Hp-hr per gal	Temperature Degrees F			Barometer inches of mercury
					Gal per hr	Lb per hp-hr		Cooling medium	Air wet bulb	Air dry bulb	
VARYING DRAWBAR POWER AND FUEL CONSUMPTION WITH BALLAST											
Maximum Available Power—Two Hours—2nd Gear											
38.58	3013	4.80	1753	4.49	3.932	0.622	9.81	170	42	46	29.015
75% of Pull at Maximum Power—Ten Hours—2nd Gear											
32.61	2321	5.27	1905	3.55	3.381	0.633	9.65	170	48	58	28.819
50% of Pull at Maximum Power—Two Hours—2nd Gear											
22.57	1562	5.42	1939	2.54	3.073	0.831	7.34	169	39	43	28.978
MAXIMUM POWER WITH BALLAST											
38.60	4791	3.02	1751	7.99	1st Gear	.....	.....	166	43	52	28.740
39.55	3106	4.78	1754	5.07	2nd Gear	.....	.....	166	43	52	28.740
38.63	2417	5.99	1749	4.03	3rd Gear	.....	.....	166	44	56	28.725
38.74	1957	7.42	1753	3.12	4th Gear	.....	.....	168	44	56	28.725
27.97	6537	1.60	1908	14.72	1st Gear	Ampli-Torc.	.....	171	52	64	28.570
37.52	5953	2.36	1753	10.49	2nd Gear	Ampli-Torc.	.....	166	43	52	28.740
37.79	4676	3.03	1753	7.73	3rd Gear	Ampli-Torc.	.....	166	43	52	28.740
37.95	3765	3.78	1754	6.15	4th Gear	Ampli-Torc.	.....	166	43	52	28.740
36.90	1489	9.29	1751	2.61	5th Gear	Ampli-Torc.	.....	167	44	56	28.725
MAXIMUM POWER WITHOUT BALLAST											
39.11	3126	4.69	1751	6.81	2nd Gear	.....	.....	171	45	53	28.970
VARYING DRAWBAR PULL AND TRAVEL SPEED WITH BALLAST—2nd Gear											
Pounds pull		3100		3250		3350		3550		3650	3550
Horsepower		39.6		37.3		33.9		31.2		27.3	21.8
Miles per hour		4.8		4.3		3.8		3.3		2.8	2.3

## TIRES, BALLAST and WEIGHT

		With Ballast	Without Ballast
Rear tires	—No, size, ply & psi	Two 13.6-38;6;20	Two 13.6-38;6;14
Ballast	—Liquid	615 lb each	None
	—cast iron	963 lb each	None
Front tires	—No, size, ply & psi	Two 6.00-16;4;28	Two 6.00-16;4;28
Ballast	—Liquid	None	None
	—cast iron	63 lb each	None
Height of drawbar		14½ inches	15 inches
Static weight	—Rear	6760 lb	3605 lb
	—Front	1560 lb	1465 lb
Total weight with operator		8495 lb	5245 lb

## Department of Agricultural Engineering

Dates of Test: April 20 to May 4, 1961

Manufacturer: MOTEC INDUSTRIES INC., HOPKINS, MINNESOTA

Manufacturer's Power Rating: Not Rated

**FUEL, OIL and TIME** Fuel regular gasoline Octane No Motor 84.7 Research 92.2 (rating taken from oil company's typical inspection data) Specific gravity converted to 60°/60° 0.7328 Weight per gallon 6.100 lb Oil SAE 10W-30 API service classification MS, DM To motor 1.577 gal Drained from motor 1.289 gal Transmission and final-drive lubricant SAE 80 Type multi-purpose gear lube Total time engine was operated 55 hours.

**ENGINE** Make Minneapolis-Moline Gasoline Type 4 cylinder vertical Serial No 16302231 Crankshaft mounted lengthwise Rated rpm 1750 Bore and stroke 3¾" x 5" Compression ratio 7.2 to 1 Displacement 206.5 cu in Carburetor size 1" Ignition system battery Cranking system 12 volt electric Lubrication pressure Air cleaner oil washed wire screen Oil filter replaceable paper element Muffler was used Cooling medium temperature control thermostat.

**CHASSIS** Type standard Serial No 16601475 Tread width rear 56" to 88" front 50" to 74" Wheel base 93¾" Center of gravity (without operator or ballast, with minimum tread, with fuel tank filled and tractor serviced for operation) Horizontal distance forward from center-line of rear wheels 29¼" Vertical distance above roadway 34¾" Horizontal distance from center of rear wheel tread 0" to the right/ left

**Hydraulic control system** direct engine drive Transmission fixed ratio operator controlled partial range power shifting Advertised speeds mph first 3.2 second 4.9 third 6.1 fourth 7.5 fifth 17.8 reverse 4.9 (Using Ampli-Torc) first 1.7 second 2.6 third 3.2 fourth 3.9 fifth 9.3 reverse 2.6 Clutch single plate dry disc operated by foot pedal Brakes double disc operated by two foot pedals Steering power assisted Turning radius (on concrete surface with brake applied) right 141" left 141" (on concrete surface without brake) right 153" left 153" Turning space diameter (on concrete surface with brake applied) right 294" left 294" (on concrete surface without brake) right 318" left 318" Belt pulley 1658 rpm at 1750 engine rpm diam 8½" face 6½" Belt speed 3635 fpm Power take-off 550 rpm at 1553 engine rpm.

**REPAIRS and ADJUSTMENTS** Four new spark plugs were installed before starting PTO runs.

**REMARKS** All test results were determined from observed data obtained in accordance with the SAE and ASAE test code.

Fifth gear was not run as it exceeded 15 mph.

We, the undersigned, certify that this is a true and correct report of official Tractor Test 789.

L. F. LARSEN

Engineer-in-Charge

L. W. HURLBUT, Chairman

G. W. STEINBRUEGGE

J. J. SULEK

Board of Tractor

Test Engineers

# EXPLANATION OF TEST REPORT

## GENERAL CONDITIONS

Each tractor is a production model equipped for common usage. Power consuming accessories can be disconnected only when it is convenient for the operator to do so in practice. Additional weight can be added as ballast if the manufacturer regularly supplies it for sale. The static tire loads and the inflation pressures must conform to recommendations in the Tire Standards published by the Society of Automotive Engineers.

## PREPARATION FOR PERFORMANCE RUNS

The engine crankcase is drained and refilled with a measured amount of new oil conforming to specifications in the operators manual. The fuel used and the maintenance operations must also conform to the published information delivered with the tractor. The tractor is then limbered-up for 12 hours on drawbar work in accordance with the manufacturer's published recommendations. The manufacturer's representative is present to make appropriate decisions regarding mechanical adjustments.

The tractor is equipped with approximately the amount of added ballast that is used during maximum drawbar tests. The tire tread-bar height must be at least 65% of new tread height prior to the maximum power run.

## BELT OR POWER TAKE-OFF PERFORMANCE

**Maximum Power and Fuel Consumption.** The manufacturer's representative makes carburetor, fuel pump, ignition and governor control settings which remain unchanged throughout all subsequent runs. The governor and the manually operated governor control lever is set to provide the high-idle speed specified by the manufacturer for maximum power. Maximum power is measured by connecting the belt pulley or the power take-off to a dynamometer. The dynamometer load is then gradually increased until the engine is operating at the rated speed specified by the manufacturer for maximum power. The corresponding fuel consumption is measured.

**Varying Power and Fuel Consumption.** Six different horsepower levels are used to show corresponding fuel consumption rates and how the governor causes the engine to react to the following changes in dynamometer load: 85% of the dynamometer torque at maximum power; minimum dynamometer torque,  $\frac{1}{2}$  the 85% torque; maximum power,  $\frac{1}{4}$  and  $\frac{3}{4}$  of the 85% torque. Since a tractor is generally subjected to varying loads the average of the results in this test serve well for predicting the fuel consumption of a tractor in general usage.

## DRAWBAR PERFORMANCE

All engine adjustments are the same as those used in the belt or power take-off tests. If the manufacturer specifies a different rated crankshaft speed for drawbar operations, then the position of the manually operated governor control is changed to provide the high-idle speed specified by the manufacturer in the operating instructions.

**Varying Power and Fuel Consumption With Ballast.** The varying power runs are made to show the effect of speed-control devices (engine governor, automatic transmissions, etc.) on horsepower, speed and fuel consumption. These runs are made around the entire test course which has two 180 degree

turns with a minimum radius of 50 feet. The drawbar pull is set at 3 different levels as follows: (1) as near to the pull at maximum power as possible and still have the tractor maintain the travel speed at maximum horsepower on the straight sections of the test course; (2) 75% of the pull at maximum power; and (3) 50% of the pull at maximum power. Prior to 1958, fuel consumption data (10 hour test) were shown only for the pull obtained at maximum power for tractors having torque converters and at 75% of the pull obtained at maximum power for gear-type tractors.

**Maximum Power with Ballast.** Maximum power is measured on straight level sections of the test course. Data are shown for not more than 12 different gears or travel speeds. Some gears or travel speeds may be omitted because of high slippage of the traction members or because the travel speed may exceed the safe-limit for the test course. The maximum safe speed for the Nebraska Test Course has been set at 15 miles per hour. The slippage limits have been set at 15% and 7% for pneumatic tires and steel tracks or lugs, respectively. Higher slippage gives widely varying results.

**Maximum Power Without Ballast.** All added ballast is removed from the tractor. The maximum drawbar power of the tractor is determined by the same procedure used for getting maximum power with ballast. The gear (or travel speed) is the same as that used in the 10-hour test.

**Varying Power and Travel Speed with Ballast.** Travel speeds corresponding to drawbar pulls beyond the maximum power range are obtained to show the "lugging ability" of the tractor. The run starts with the pull at maximum power; then additional drawbar pull is applied to cause decreasing speeds. The run is ended by one of three conditions: (1) maximum pull is obtained, (2) the maximum slippage limit is reached, or (3) some other operating limit is reached.

For additional information about the **Nebraska Tractor Tests** write to the Department of Agricultural Engineering, University of Nebraska, Lincoln, Nebraska.



Minneapolis-Moline 4 Star Gas